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PROPOSED MODERN MARINE TERMINAL AT SAN DIEGO

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WATERWAYS DIVISION

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PROPOSED MODERN MARINE TERMINAL AT SAN DIEGO[a]

Joachim E. Liebmann,[1] M. ASCE

It is not very often that the Engineer of an established port has the chance to plan a major shipping terminal without being hampered by an annoying number of limitations and restrictions. Only too often is the contour of a new pier or wharf predetermined by adjacent facilities or by the structure it is replacing. Usually there is insufficient area available on or behind the wharf for open storage. At other times the rail and truck approaches are restrictive factors.

Fortunately, none of these restrictions will hinder a rational development of San Diego's 10th Avenue Marine Terminal, a huge proposed quay wharf estimated to cost $13,000,000. The need for this facility has long been recognized in this City. In fact, shortly after the last war, bids were secured for the construction of a finger pier 600 feet wide and extending 1000 feet from the U. S. Bulkhead Line to the Pierhead Line. In view of revised planning it was perhaps fortunate that bids had to be rejected because of a minor technicality. Increase in shipping through this Port in recent years and an even greater potential use of San Diego's port facilities emphasize the need for this development.

The plan appears to be simple enough. Nevertheless, it incorporates ideas of many agencies with a diversity of interests. Among these are:

Steamship lines who insist on a fast turnaround of vessels;

Stevedoring and warehousing companies with a view toward efficient cargo handling and storing;

Truckers and railroad operators looking for uncongested approaches and loading areas;

Port pilots whose main concern is the safe berthing of vessels;

Insurance Underwriters prone to see impending disaster;

Contractors interested in ease of construction.

The plan has been developed with the cooperation of the Port's Consulting Engineer, Mr. George F. Nicholson, whose familiarity with marine terminals elsewhere has resulted in invaluable advice.

Location and Size

There are at least three other possible locations for a new shipping terminal along the City's bay front, although none of these combines all the advantages held by the proposed site at the foot of 10th Avenue, as shown on Plate No. 1.

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a. Prepared for presentation before the American Society of Civil Engineers Convention at San Diego, Calif., February 7 to 12, 1955.

1. Chief Eng., Port of San Diego, Calif.

Here is available half a mile of unobstructed waterfront. The main navigation channel beyond the pierhead line has been dredged to 30 feet M.L.L.W. Shoreward of the bulkhead line are 43 acres of filled but otherwise undeveloped tidelands. Adjacent to these lie the marshaling yards of the Santa Fe and also the San Diego and Arizona Eastern Railroads. Other important factors are the proximity to the City's main business district and the favorable location with respect to highways leading out of the City.

Larger ships and speedier handling of cargo demand more and more storage space for each ship's berth. Actually, a good many more vessels could be berthed alongside the present facilities, but there is insufficient room to accumulate and store their cargo. The solution to the Port's congested facilities is the construction of the quay or marginal wharf, as shown on Plate No. 2.

The outer face of the proposed wharf will be 2600 feet long and will coincide with the pierhead line. The width, extending from the bulkhead to the pierhead line, will be approximately 1000 feet.

Another advantage of the quay wharf is that vessels can be berthed more easily and can be shifted more readily from one berth to another.

Plate No. 3 shows the layout of the two finger piers formerly proposed, which has some obvious disadvantages.

1) The depressed track area between the transit sheds would be hopelessly congested when truck and trailer units are backed to the loading platforms.

2) The width of the transit sheds is limited.

3) Ships are more difficult to berth.

4) There are no open storage areas available on the pier for the handling of lumber, steel, and bulk commodities.

Rock and Concrete Wall

The first item to be constructed, incidentally the most costly one, will be the wharf itself. Plans call for the use of a so-called Cyclopean concrete gravity wall, as shown on Plate No. 4, which will retain the dredger fill. This type of construction was used locally about five years ago in building the first 672 lineal feet of the 10th Avenue Pier and in the extension of the 28th Street Pier. During the last decade it has also been used successfully in the construction of quay walls at Long Beach Harbor and the Navy Ammunition Depot at Seal Beach, California.

The Cyclopean concrete wall is built by placing underwater large rock, say 100 pound to four ton, in layers about five feet thick and filling the interstices with tremie concrete. Bottom opening buckets of large capacity, tremie pipes, or similar means may be used to place the underwater concrete with very little segregation. Only the face requires forming. On the previous projects in San Diego precast concrete slabs sliding in steel H - columns were used for this purpose. A smooth face may be secured by holding back the rock about two feet from the forms thus leaving a solid concrete wall on the face of the wharf. Above elevation plus three M.L.L.W. mass concrete is used.

The top of the wall will be held at plus 12 and the bottom at minus 37, which will provide for a maximum draft of 35 feet at extreme low tide of minus 2. This should accommodate even the largest cargo ships for a great many years to come.

Borings to determine the bearing capacity of the bottom will be taken along the entire length of the wall. Some previous borings made in this locality indicate that the base of the wall will probably rest on fine sand which should be capable of supporting 3 tons per square foot. The soil pressure at the toe has been computed in excess of 4 tons per square foot. Two rows of untreated wood piling, which will be entirely encased in the concrete and the bottom material, will be driven along the toe to prevent settlement. Piling was not used under the gravity walls constructed here a few years ago; however, they extend only to a depth of minus 33 feet. The elevation of the top of these walls has been checked at intervals. No appreciable settlement has been detected.

The fill immediately behind the wall must be carefully selected. Coarse dredger sand is ideal since it has a fairly steep angle of repose and will make a well compacted fill with little subsequent shrinkage. It would be disastrous to permit a mud fill next to the wall because the high lateral pressure could overturn the wall.

In cost this type of construction compares favorably with other permanent types such as concrete piled apron wharves or steel cell construction. A deep mud layer, of course, would prevent its use. Also, it would probably become uneconomical where water depths exceed forty feet.

The more obvious advantages of the gravity wall construction are:

1) Maintenance cost is practically eliminated.

2) Floor loads on the pier even next to the ships are almost unlimited.

3) It is entirely fire proof.

4) There is no danger of losing the fill as in the case of sheet pile or concrete slab bulkheads.

5) A more economical fender system may be used.

The new wall at the 10th Avenue quay wharf will most likely be equipped with tubular rubber fenders suspended horizontally above the high water line. Severe attack by marine borers particularly limnoria limits the life of creosoted Douglas Fir piling in this Harbor to about eight years and greatly discourages its use. The vertical face of the gravity wall is ideally suited to the use of the more resilient rubber fenders.

Transit Sheds and Storage Warehouses

The new wharf would be of little practical value without extensive covered storage areas. Plans call for four huge buildings, two transit sheds along the outboard face of the wharf and two storage warehouses occupying the center portion of the new fill, comprising a total covered area of one million square feet.

Cargo with rapid turn-over would normally be stored or accumulated in the transit sheds. The warehouses are intended for cargo with long term storage.

Each transit shed will be 1000 feet long and since there is ample space on the pier the sheds can be made 200 feet in width with a 14 foot raised loading dock along the backside. Each of the five berths along the outboard face will therefore be served by 80,000 square feet of transit shed space which is considered adequate but not excessive.

Plate No. 5 shows a cross-section through the pier with the relative

location of transit sheds and warehouses. The vertical scale has been exaggerated for the sake of clarity. It will be noted that the floor of the transit shed slopes upward toward the loading platform. This has been done to keep the ground outside the buildings at about the same elevation, unquestionably desirable for heavy truck traffic and even more so for rail traffic.

All of these buildings will be designed along the lines of Shed No. 2 on "B" Street Pier and of Warehouse "A" near the proposed terminal which were recently completed at a surprisingly low construction cost.

The outside walls will be six-inch tilt-up concrete. Concrete fire walls, 12 inches thick, will divide the transit sheds and warehouses into fire divisions of fifty thousand square feet in compliance with the requirements of the City Building Code and the Cotton Warehouse Inspection Service.

Although the advantages of clear span construction are appreciated, a reasonable number of interior columns will nevertheless be permitted in the interest of economy and probably spaced 60' to 70' on centers. Roof beams and girders most likely will be of prestressed concrete, however, consideration will also be given to the possible use of tapered steel girders or steel trusses. The wood roof, consisting of 3" x 8" stringers and 5/8 inch plywood sheathing, will be designed as a diaphragm capable of carrying horizontal wind and seismic loads to the outside and fire walls. Plywood sheathing will be covered with four ply coal tar and gravel roofing expected to give a maintenance-free life of twenty to thirty years.

Fluorescent fixtures or possibly a 480Y/277 volt distribution system utilizing mercury vapor lamps will be used to light the interior of the buildings as well as the adjacent loading docks and wharf apron.

All buildings, of course, will be completely sprinklered and will have the usual large steel rolling doors in all outside and fire walls.

Roads and Open Storage Areas

A modern marine terminal should have wide roadways and large open storage areas. This was a paramount consideration in planning the 10th Avenue Wharf. It will be noted, for instance, that the paved area between the transit sheds and the warehouses was made 205 feet wide. With trailer trucks backed to the loading docks of these buildings there will still be adequate room for two-directional truck traffic as well as railway traffic.

A limited amount of paved open storage space will be provided on the wharf itself. Much larger areas will be developed just shoreward of the wharf.

There exists now an access road at each end of the area. Nevertheless, a more direct connection with Harbor Drive will have to be constructed, preferably one which will avoid level crossing of this thoroughfare. This can be accomplished most economically by taking advantage of the existing highway overpass spanning the Santa Fe tracks.

Railroad Trackage

In spite of the increasing percentage of truck traffic (now approximately 75%) railroads for a long time will undoubtedly continue to carry mass shipments. Plans call for over five miles of railroad tracks on the wharf and in the adjacent area.

Sub-surface Structure and Utilities

Little need be said concerning the utilities such as water lines, sewers, telephone and power ducts and manholes, fire alarm systems, etc. Because of the frequent use of truck cranes and similar equipment, power and telephone lines should also be placed underground. Past experience has shown that utilities should be designed with ample capacity for increased demands in the future. This is particularly true with respect to power ducts where spare capacity can be provided at low additional cost. It is difficult to foresee power demands occasioned by advances in mechanized cargo handling.

Before any filling work is started a new storm drain must be constructed to replace the present inadequate culvert running from the Santa Fe right-of-way to the bulkhead line. The new drain, with a cross-sectional area of about 260 square feet, will discharge the Switzer Canyon runoff near the northwest corner of the wharf. Its entire length must be covered so as not to impair the use of the open storage area.

Appurtenant Work

The terminal will possess the usual and perhaps some special appurtenant facilities. The more important ones will be:

1) Equipment for handling bulk cargo:
Bulk cargo will be handled along the southeast face of the wharf, the preferable location in view of the prevailing westerly winds. The precise type of equipment will be selected several years from now and will depend on the use anticipated at that time. Present thinking favors one or two gantry cranes of about twenty ton capacity.

2) Tankage for edible oils, molasses, etc.:
The plan calls for future installation of four to six tanks, each of about 300,000 gallon capacity, with the necessary pumps, pipe lines, and loading risers. Here again, actual need will determine the extent of this development.

3) Elevated Water Tank:
A 100,000 gallon elevated tank will be erected to provide a secondary source of water for fire protection purposes.

4) Office Building:
Office space must be provided to accommodate steamship agents, freight forwarding companies, brokers, insurance offices, etc.

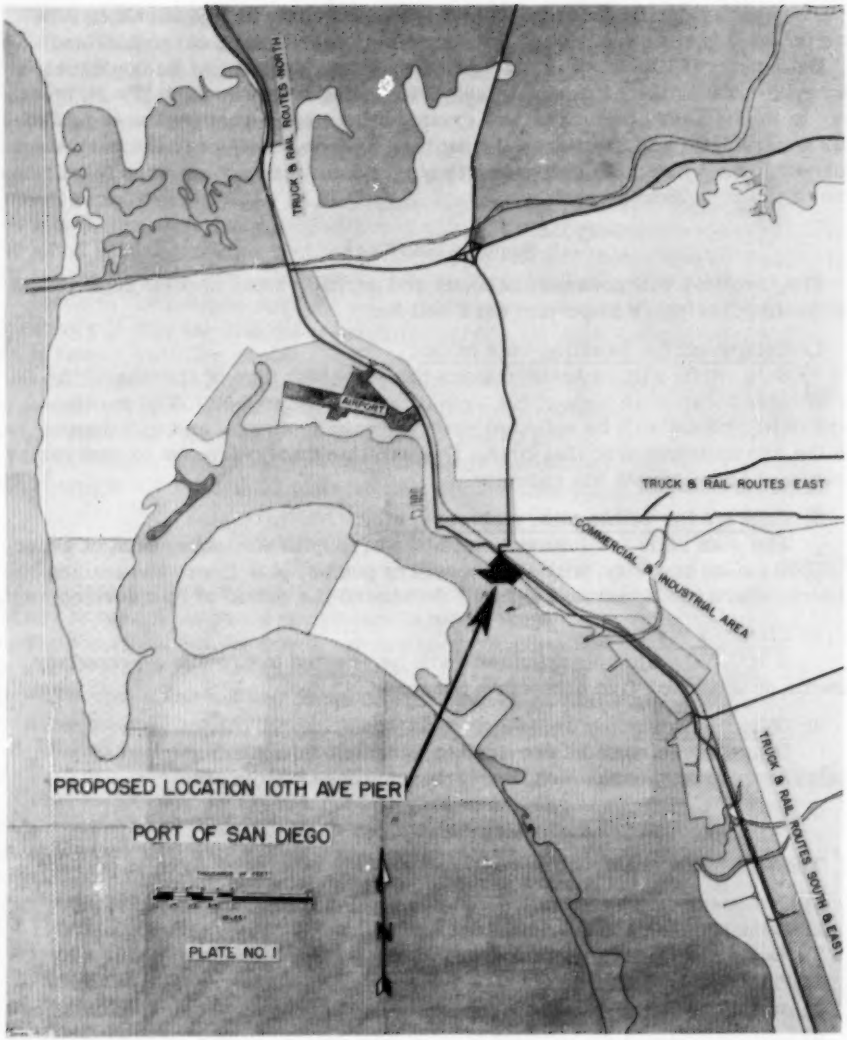
Estimated Cost

The estimated construction cost may roughly be broken down as follows:

1) Cyclopean Concrete Wall, Dredging and related work	$ 4,750,000
2) Transit Sheds and Warehouses	3,900,000
3) Roads and Open Storage Areas	1,162,800
4) Railroads and Utilities	1,383,200
5) Appurtenant Facilities	1,263,000
6) Contingencies - 5%	622,950
TOTAL CONSTRUCTION	$ 13,081,950

Engineering costs are not included.

The issuance of general obligation bonds in the amount of $9,460,000 to finance the bulk of this project has been proposed and the proposition will be placed before San Diego's voters in April. If approved, the development should be completed in three years.


TRUCK & RAIL ROUTES NORTH
AIRPORT
TRUCK & RAIL ROUTES EAST
COMMERCIAL & INDUSTRIAL AREA
TRUCK & RAIL ROUTES SOUTH & EAST
PROPOSED LOCATION 10TH AVE PIER
PORT OF SAN DIEGO
PLATE NO. 1

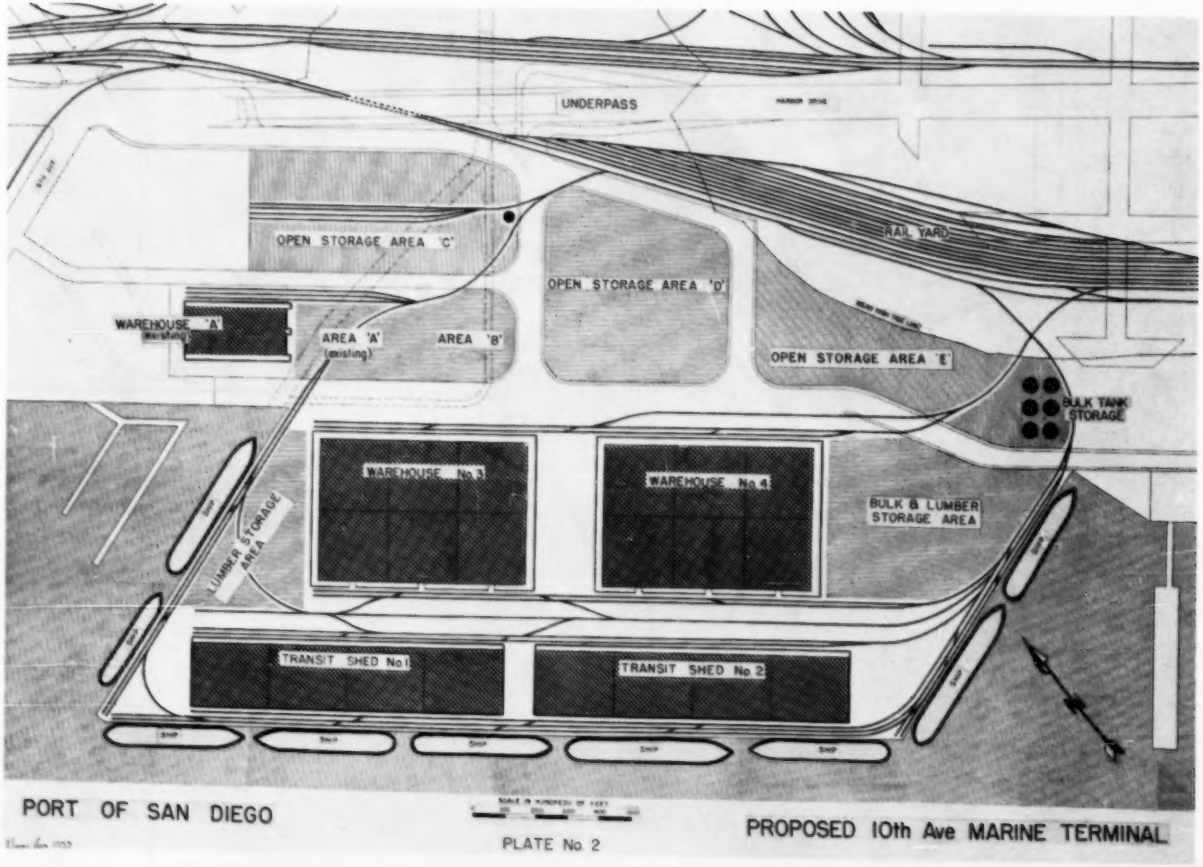
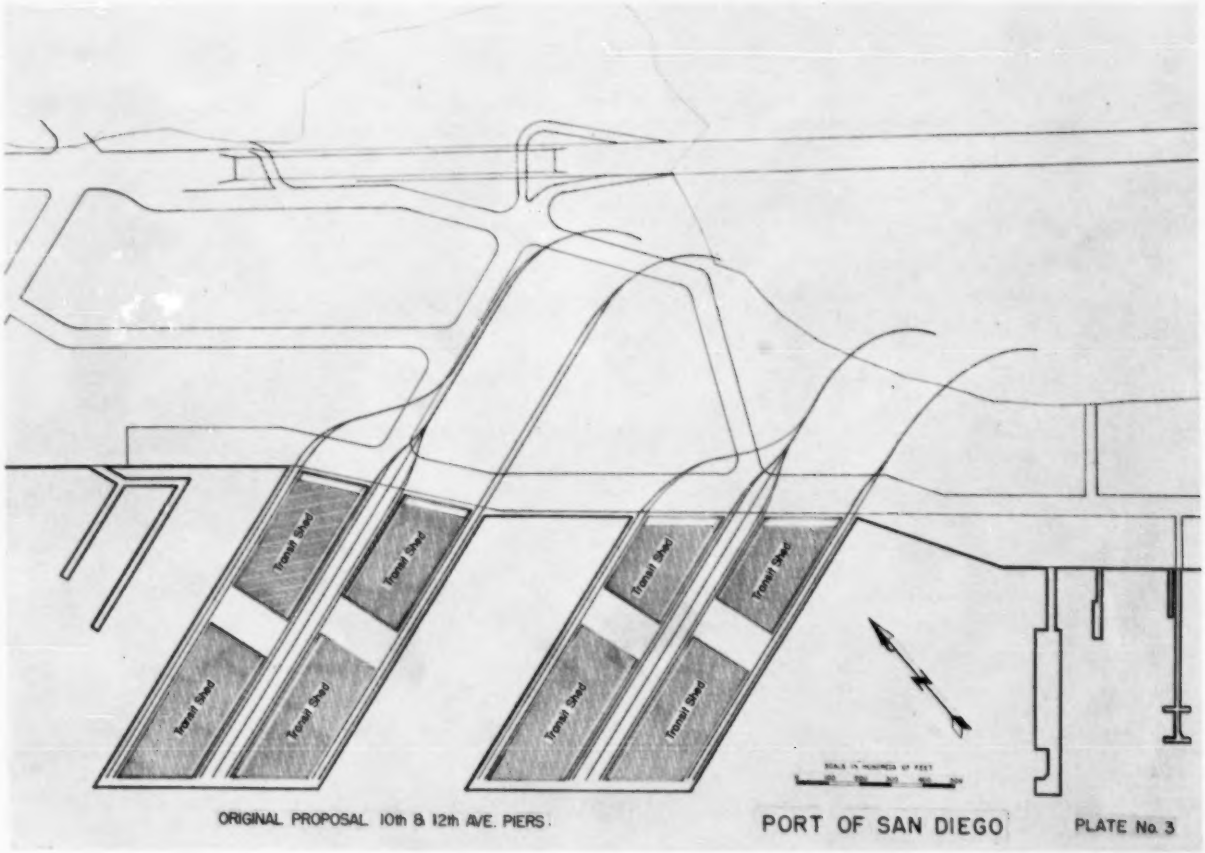

UNDERPASS
HARBOR DRIVE
OPEN STORAGE AREA 'C'
OPEN STORAGE AREA 'D'
RAIL YARD
WAREHOUSE 'A'
(existing)
AREA 'A'
(existing)
AREA 'B'
OPEN STORAGE AREA 'E'
BULK TANK STORAGE
WAREHOUSE No. 3
WAREHOUSE No. 4
BULK & LUMBER STORAGE AREA
LUMBER STORAGE AREA
TRANSIT SHED No. 1
TRANSIT SHED No. 2
SHED
PORT OF SAN DIEGO
PROPOSED 10th Ave MARINE TERMINAL

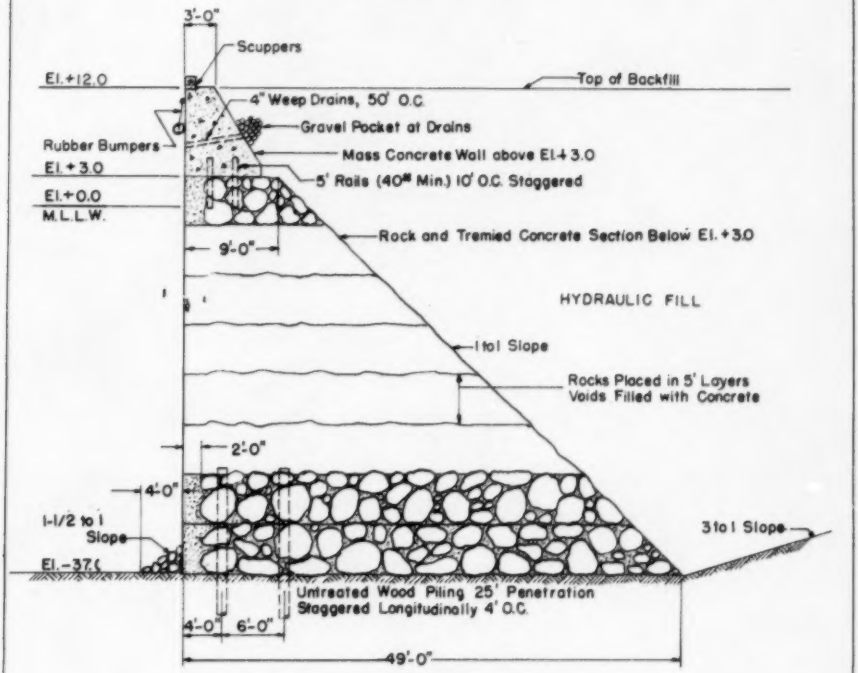
PLATE No. 2



ORIGINAL PROPOSAL 10th & 12th AVE. PIERS.

PORT OF SAN DIEGO

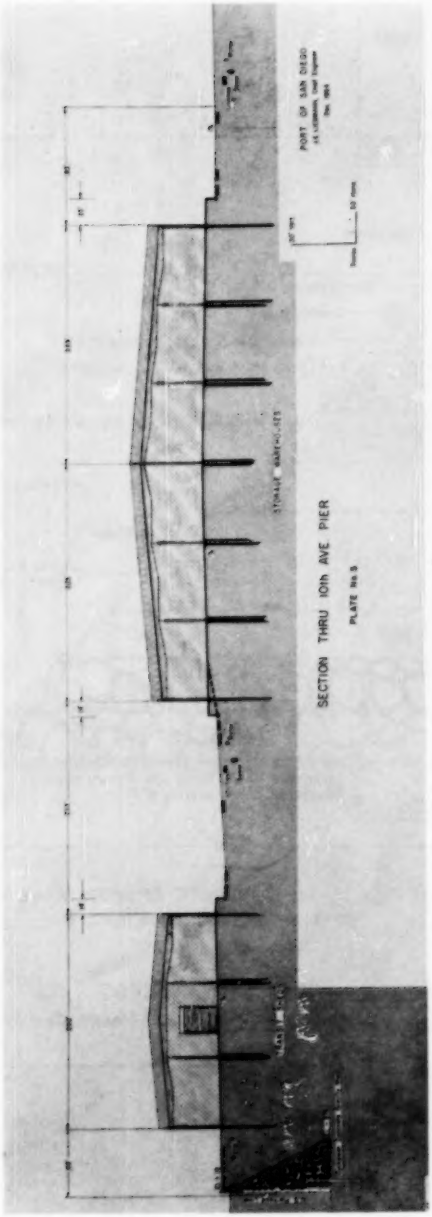
PLATE No. 3



CYCLOPEAN CONCRETE GRAVITY WALL
FOR WHARF CONSTRUCTION

PORT OF SAN DIEGO

PLATE No. 4 J.E.LIEBMANN, Chief Engineer


PORT OF SAN DIEGO
SECTION THRU 10th AVE PIER
PLATE No 5